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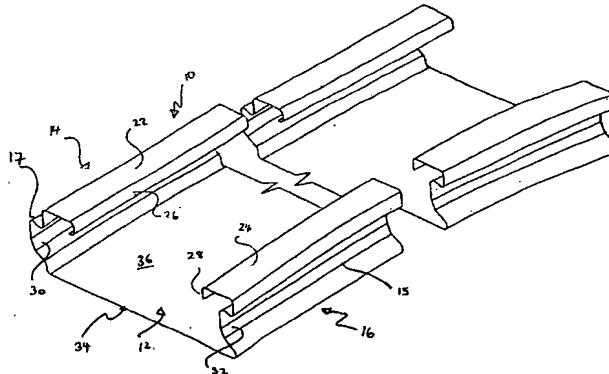
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(54) Title: FORMING APPARATUS FOR PRECAMBERED METAL SECTIONS



WO 2004/085085 A1
(57) Abstract: A forming apparatus (50) includes a roll former (51) operative to roll form a metal strip (100) to form a profiled metal section (10) of generally C section profile including a pan (12) and a pair of upstanding edge margins (14 and 16). The section profile incorporates a longitudinal camber which is introduced by the forming apparatus by incorporating a prestretching apparatus (52) upstream from the roll former (51), and a bending apparatus (53) located downstream of the roll former (51). The prestretching apparatus differentially stretches the metal strip (100) in its longitudinal direction so as to form portions (101, 102), which are more elongated than a laterally adjacent portion (103) of the strip (100). The differential stretching compensates for longitudinal shortening of the metal strip in forming the profiled section in the roll former (51). The bending apparatus (53) uses a (3) point bending process and includes a reaction stage (60), a fulcrum stage (61), and an action stage (62). The action stage (62) which induces loading onto the profiled section (10) so as to bend the section about the fulcrum stage (61) is incorporated with the shearing assembly. A method of forming a metal section from sheet metal strip is also disclosed. In a further aspect a shearing assembly is disclosed which is height adjustable and which also includes a cutting element (77) and shearing block (78) which are pivotally mounted to an assembly frame (74).

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FORMING APPARATUS FOR PRECAMBERED METAL SECTIONS

Technical Field

5 The present invention relates to an apparatus for and method of, forming a metal section from sheet metal strip. The invention has been developed especially for roll forming metal profiles such as metal decking and the invention is herein described in that context. The
10 invention however has broader application and is not limited to that particular use.

Background of the Invention

15 Composite structures formed from metal decking on which a concrete slab is cast are commonly used in building. Typically, the decking is installed on site so as to span supporting elements, such as columns or walls. The decking includes a pan section and upstanding edge
20 regions which are in abutting relationship so as to form a continuous surface. Concrete is cast over the surface so that the upstanding edges are embedded in the slab. The metal decking therefore acts both as formwork for casting of the slab, and also provides tensile strength to the
25 structure on curing of the slab.

 In the applicants' earlier International applications, PCT/AU01/01446, and PCT/AU01/01447, an improved metal decking is disclosed which incorporates a precamber in the longitudinal direction of the decking.
30 The purpose of the precamber is to compensate for deflection of the decking on casting of the slab thereby enabling the decking to span greater lengths without exhibiting excessive deflection of the composite structure. The decking in these earlier applications also
35 discloses an improved edge interlock arrangement which further improves the strength of the composite structure.

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Whilst metal decking according to the above form has improved performance, difficulties have been encountered in incorporating the precamber into the metal section.

5 Summary of the Invention

Accordingly, in a first aspect invention relates to a method of roll forming a metal section from sheet metal strip comprising of the steps of;

- 10 - differentially stretching the metal strip in its longitudinal direction so that at least one portion of the metal strip is more elongated than a laterally adjacent portion of the strip;
- roll forming the differentially stretched metal strip to
15 form a profiled section; and
- bending the profiled section so as to introduce a longitudinal precamber in the profiled section.

An advantage of the present invention is that the profile and precamber can be introduced into the section
20 in a single pass. Furthermore, the method can be easily introduced into an existing roll forming line merely by including additional processing stations.

The applicants have found that by preconditioning the metal strip through differential prestretching, the amount
25 that the metal section can be bent without buckling of the section, or introducing significant areas of weakness in the metal section, can be significantly increased.

In one form, the metal strip is differentially stretched continuously in a longitudinal direction of the
30 metal strip, so as to produce longitudinally extending elongated portions in the metal strip.

In one form, the differential stretching is designed at least in part to compensate for the tendency of some parts of the metal section to shorten longitudinally as a
35 result of lateral bending during roll forming of the metal strip.

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In formation of a metal sections having shaped flanges that project in one direction from a web, the metal section tends to bow longitudinally inwardly, with its centre of curvature on the opposite side of the web to which the flanges project. This occurs because rollforming to shape the flanges results in longitudinal shortening of the flanges. The differential stretching is designed to compensate at least in part for the tendency of the bent sections of the metal strip to shorten longitudinally so as to cause the metal strip to bow. This bending of the profiled section is about the face opposite to that in which the upturned edges of the section extend.

In one form, the metal strip is stretched in portions that are stretched to induce the required precamber in the final roll formed product.

In one embodiment, the metal strip is roll formed so as to be differentially stretched.

In one form, the profiled section is caused to bend about a fulcrum to introduce a longitudinal precamber. In one embodiment, the profiled section is restrained upstream from the fulcrum and is caused to be deflected from the roll forming line downstream of the fulcrum. In this arrangement, a three point bending process is formed to introduce the longitudinal precamber.

In one form, the apparatus to shear the profiled section into discrete lengths is used as part of the three point bending process. In one form, the shearing apparatus is adjustable so that it can be set to cause the profiled section to be deflected from the general line of the roll former. In that arrangement, the metal section at the shearing apparatus is inclined to the line of the roll forming. In a preferred form, the cutting surface of the shearing apparatus can be similarly inclined so that the shearing action remains perpendicular to the metal section.

In a further aspect, the invention relates to an

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apparatus for forming a metal section from sheet metal strip, the apparatus comprises:

stretching apparatus which is operative to differentially stretch the metal strip in its longitudinal
5 direction so that at least one portion of the metal strip is more elongated than a laterally adjacent portion of the strip;

rollforming apparatus operative to roll form the differentially stretched to form a profiled section; and

10 bending apparatus operative to bend the profiled section so as to introduce a longitudinal precamber in the profiled section.

In a further aspect, the present invention relates to a shear assembly for use in cutting a profiled metal
15 section, the shearing assembly comprising an assembly frame, a shearing block attached to the frame and operative to receive the profiled metal section, and a cutting element which is moveable relative to the shearing block; wherein the shearing assembly is height adjustable
20 so that the relative height of the shearing block can be adjusted and the angle of the cutting element relative to the frame can be adjusted.

Brief Description of the Drawings

25

It is convenient to hereinafter describe an embodiment of the present invention with reference to the accompanying drawings. The particularity of the drawings and the related description is to be understood as not
30 superseding the generality of preceding the broad description of the invention.

Fig. 1 is a schematic perspective view of metal decking for use in a composite structure;

Fig. 2 is a schematic side view of an apparatus performing the metal section of Fig. 1;

Fig. 3 is a detailed perspective view of a prestretching apparatus in the system of Fig. 2;

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Fig. 4 is a front elevation of the prestretching apparatus of Fig. 3;

Fig. 5 is a side elevation of the prestretching apparatus of Fig. 3;

5 Fig. 6 is a front elevation of a reaction station in the rollforming system of Fig. 1; and

Fig. 7 is a front elevation of the fulcrum station of the system of Fig. 1.

Fig. 8 is a side elevation of the action stage of the
10 Fig. 1.

Fig. 9 is a front elevation of the action stage of Fig. 1.

Fig. 10 is a top elevation of the action stage of Fig. 1.

15 Fig. 11 is a front elevation of the action rollers of Figs 8, 9 and 10.

Detailed description of the preferred embodiment

20 As shown in Fig. 1, a metal decking 10 is disclosed which is elongate and of generally C-section profile including a pan 12 and a pair of upstanding edge margins 14, 16 respectively. The metal decking member 10 in use is interconnected with a like member so as to form metal decking. The metal decking is designed with edge margins of one sheet abutting the other edge margins of an adjacently laid sheet and a concrete slab is cast onto the decking which embeds the upstanding edge margins 14 and 16.

30 Each of the upstanding edge margins 14 and 16 include webs 15, 17 that extend upwardly from the pan 12. Flanges 22, 24 extend inwardly from an upper end of respective ones of the webs 15, 17 and includes a respective lip return 26, 28. One lip return 26 is turned back towards its web 15, whereas the other lip return 28 is disposed generally parallel to its web 17.

The web 15, 17 of edge margins 14 and 16 each include

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a respective longitudinally extending rib (30, 32). These longitudinal ribs are configured so that when adjacent decking members are laid, the rib 30, 23 of one edge margin interlocks with the other web 30 of the adjacent 5 decking member to inhibit vertical separation of the metal decking members 10. This interlocking of the ribs eliminates the need for fasteners to secure adjacent decking members together. In the embodiment shown, the ribs interlock through their complimentary shape so that 10 one of the ribs 30 resides within the other rib 32 of a decking member.

In addition, the pan 12 of the metal decking member 10 is longitudinally precambered about a bottom face 34 of the pan 12. The precamber of the web is about 0.6% 15 measured as the maximum longitudinal offset of the pan 12 from a substantially flat plane and it is expressed as a percentage relative to the length of the member 12. In a typical arrangement, the decking member 10 is supplied in 6 metre lengths, and the maximum offset located in the 20 middle of the member 10 is about 35 mm.

In use, concrete is cast on an upper face 36 of the pan 12. Under the load of the cast concrete, the member 10 is caused to at least partly deflect towards the flat plane under the significant weight of this concrete. The 25 advantage of this longitudinal precamber is that it minimises the deflection from a flat line of the metal decking once the concrete slab has been cast. As the maximum deflection is a criteria for determining the span lengths of the metal decking member 10, it allows the 30 limit of the span length criteria to be extended. Another limiting factor on the span length is the strength at the interlock of the adjoining upstanding region between adjacent decking members. The use of the ribs 30 and 32 increases the strength at this interlock. As a result of 35 the precamber and the increased strength at the interlock, the metal decking member 10 is able to span to about 5 metres unsupported as compared to spans of 3 metres for

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conventional decking member without a longitudinal precamber.

Figs. 2 to 11 illustrate a forming apparatus 50 to make the decking member 10 from sheet metal strip 100.

- 5 The roll former 50 both shapes the section and incorporates the precamber.

The forming apparatus 50 includes a roll former 51 having series of 27 rollforming stages which shapes the decking member 10. These rollforming stages are not the 10 subject of the invention and are therefore not illustrated in any detail. The forming apparatus 50 also includes an additional prestretching apparatus 52 located upstream of the roll former 51, and bending apparatus 53 located downstream of the roll former 51 and which precambers the 15 member 10. Both these apparatus 52, 53 are disclosed in more detail below.

Turning firstly to the prestretching apparatus 52 which is best illustrated in Figs. 3 to 5. The apparatus 52 is constructed as a single stage device and is designed 20 to differentially stretch the strip 100 so that it includes longitudinally extended portions 101, 102 which are more elongated than a mid section of the strip 103. The elongated portions 101, 102 are located adjacent the edge margins of the strip 100 in the area where the strip 25 is subjected to maximum bending in the roll former 51 in forming the profile. This prestretching apparatus 52 is designed to precondition the strip 100 so as to inhibit its tendency to bow about the upper face 36 of the metal decking member 10 which would otherwise occur during the 30 rollforming. This tendency to bow upwardly is caused by a relative foreshortening of the edge margins caused in forming the upstanding edge margins 14, 16 of the member 10.

The prestretching apparatus 52 uses rollers 55, 56, 35 57, 58 and 59 to differentially stretch the strip 100 as best illustrated in Figs. 4 and 5. These rollers are configured in a two over three arrangement and are

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designed so that they are disposed in the vicinity of the longitudinal edge margins of the strip 100. Further, each roller is tapered (as best illustrated in Fig. 4) so that the amount of stretching varies across each roller.

5 On exiting the prestretching apparatus 52, the strip 100 is then fed into the rollformer 51. After passing through the stages of the rollformer 51, the shaped metal profile 10 is then introduced into the bending apparatus 53 which bends the member 10 about its lower face 34.

10 To bend the member 10 to induce a precamber into the member 10, a three point bending process is used which requires that the bending apparatus 53 includes three separate stages; a reaction stage 60, a fulcrum stage 61, and an action stage 62. With this arrangement, the 15 product is arranged to be bent around the fulcrum stage 61 whilst being supported in the reaction stage 60. The action stage is height adjustable so that it can be located below the line of the other stages of the roll former (51, 52, 60 and 61) so as to introduce the bend into 20 the member 10. The amount of bending is dependent on the amount the action stage 62 is offset from the line of the other stages of the roll former 50.

Fig. 6 illustrates the reaction stage 60 in more detail. In that stage, the member 10 is well supported 25 with the pan 12 being captured between an infill roll 63 and floating block 64. The upper end 22, 24 of the upstanding margins 14 and 16 are in engagement with upper rollers 65 and 66. This arrangement enables the profile 10 to be well supported and in particular to resist any 30 lifting of the web 12.

Fig. 7 illustrates the fulcrum stage 61. The fulcrum stage 61 includes an infill roller 67 and blocks 68. The pan 12 of the member 10 is captured below the roller 67 and blocks 68, as in the reaction stage 60. However, 35 unlike the reaction stage 60, the upper ends of the margins 14 and 16 are not restrained thereby allowing the member 10 to bend about the infill roll 67. The bending

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is required to enable the profile to introduce the required precamber.

In addition, the infill roll 67 in the illustrated form incorporates a tapered surface 69 which tapers from a 5 mid point 70. This tapered roller introduces a lateral precamber across the web 12 as illustrated in Fig. 7. This lateral precamber may be retained in the final profiled section, but in the illustrated arrangement is only incorporated in this stage to assisting in forming 10 the precamber. As the profiled section exits the fulcrum stage, the metal springs back so that it is generally flat as it enters the action stage 62.

In alternate arrangements (not shown) the infill roll 66 incorporates a flat surface that maintains a flat 15 profile across the web 12.

Figs. 8 to 11 illustrate the action stage 62. The action stage 62 induces the loading on the member 10 that induces the bend to the member at the fulcrum stage 61. This loading is resisted at the reaction stage 60. The 20 action stage 62 comprises a height adjustable table 71 with a mounting plate 72 to which an action roll assembly 73 and shear frame assembly 74 are mounted. The height adjustable table 71 provides adjustment via a plurality of jack screws 75 which control the relative height of the 25 action roll assembly 73 thereby allowing control of extent of curvature of the member 10.

Fig. 11 illustrates the action roll assembly 73. A pair of action rolls 83, 84 both guide the member 10 into the shear frame assembly 74 and also applies load to the 30 member 10 to provide for bending the member 10. The spacing between the action rolls 83 and 84 can be adjusted through adjustment bolts 85 to thereby cater for different sized profiles.

The shear frame assembly 74 houses a tilting shear 35 assembly 76 comprises an actuated blade assembly 77 and a reaction surface assembly 78. The perpendicularity in the cutting of the member 10 is maintained by the shear

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assembly 76 being able to pivot on a bearing 79. The angle of tilt of the shear assembly 74 is able to be varied but is fixed in a selected position through the angular adjustment bolts 80 that are movable along their 5 axis relative to the shear frame assembly 74.

Fixed at the top of the tilting shear assembly 76 is a hydraulic cylinder (not shown) that actuates a moving blade 81. The reaction surface assembly 78 has two fixed shear blades 82 that remove a section (slug) of member 10 10 when the moving blade 81 is actuated, wherein the removed section is ejected via a chute 86.

In operation, metal strip is introduced into the apparatus 50 and is initially prestretched (by apparatus 52), profiled (by the roll former 51) and then 15 precambered (by apparatus 53), whereafter it is cut into discrete lengths by the shear assembly 76. Accordingly, the rollforming apparatus 50 provides a system where the metal strip can be profiled and precambered in a single operation. Furthermore, the equipment required to the 20 apparatus 50 to form the precamber in the member 10 may be easily introduced into an existing rollforming line merely by including additional stages. Furthermore by preconditioning the metal strip through differential prestretching, the amount the metal section can be bent at 25 the bending stage is increased without the risk of buckling of the section or introducing significant areas of weakness. With this arrangement, it is possible to introduce longitudinal precambers in the order of 6% as advantageously used in the decking member 10.

30 In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, 35 i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

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Variations and modifications may be made to the parts previously described without departing from the spirit or ambit of the present invention.

THE CLAIMS:

1. A method of roll forming a metal section from sheet metal strip comprising of the steps of;
 - 5 differentially stretching the metal strip in its longitudinal direction so that at least one portion of the metal strip is more elongated than a laterally adjacent portion of the strip;
 - roll forming the differentially stretched metal strip
 - 10 to form a profiled section; and
 - bending the profiled section so as to introduce a longitudinal precamber in the profiled section.
2. A method according to claim 1, wherein the metal strip is differentially stretched continuously in a longitudinal direction of the metal strip, so as to produce longitudinally extending elongated portions in the metal strip.
- 15 3. A method according to claim 1 or 2, wherein portions of the metal strip shorten longitudinally in forming the profiled section and the metal strip is differentially stretched so as to compensate for the longitudinal shortening of the strip in roll forming the profiled section.
- 20 4. A method according to any one of claims 1 to 3, wherein in bending the profiled section to introduce the longitudinal precamber, the metal of the profiled section is stretched, and wherein the metal strip is differentially stretched in portions that facilitate the stretching of the metal in the profiled sections during the step of bending of the profiled section.
- 25 5. A method according to any preceding claim, wherein the profiled section is of a generally C-shape having a pan section and upturned edge margins which extend from one face of the strip, and wherein the profiled section is bent about the face opposite to that in which the upturned edge margins of the profiled section extend.
- 30 6. A method according to any preceding claim, wherein

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the metal strip is roll formed so as to be differentially stretched.

7. A method according to any preceding claim, wherein the profiled section is caused to bend about a fulcrum to 5 introduce the longitudinal precamber.

8. A method according to claim 7, wherein the profiled section is restrained upstream of the fulcrum, and is loaded downstream of the fulcrum to induce bending of the profiled section about the fulcrum.

10 9. An apparatus for forming a metal section from sheet metal strip, the apparatus comprising;
stretching apparatus which is operative to differentially stretch the metal strip in its longitudinal direction so that at least one portion of the metal strip
15 is more elongated than a laterally adjacent portion of the strip;

roll forming apparatus operative to roll form the differentially stretched strip to form a profiled section; and

20 bending apparatus operative to bend the profiled section so as to introduce a longitudinal precamber in the profiled section.

10. A forming apparatus according to claim 9, wherein the stretching apparatus includes at least one roll which is
25 operative to engage a portion of the metal strip so as to elongate the engaged portion of the strip.

11. A forming apparatus according to claim 10, wherein the roll has a tapered surface so as to vary the amount of stretching across said engaged portion of the metal strip.

30 12. A forming apparatus according to any one of claims 9 to 11, wherein the bending apparatus comprises a multiple stage device which is operative to introduce a three point bend to said profiled section.

13. A forming apparatus according to claim 12, wherein
35 the bending apparatus includes a reaction stage operative to restrain the metal profile, a fulcrum stage about which the profiled section bends, and an action stage which is

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operative to induce a load on said profiled section so as to induce bending of the profiled section about the fulcrum stage.

14. A forming apparatus according to claim 13, wherein
5 the action stage is adjustable in height relative to the fulcrum stage so as to enable the amount of precamber introduced into the profiled section to be varied.

15. A forming apparatus according to claim 13 or 14,
wherein the action stage is incorporated as part of the
10 shearing assembly which is operative to cut said profiled section in discrete lengths.

16. A forming apparatus according to claim 15, wherein
the shearing assembly comprises a shearing block operative
to receive the profiled metal section, and a cutting
15 element which is moveable relative to the shearing block,
wherein the shearing assembly and the action stage are
mounted to a common assembly frame which is height
adjustable.

17. A forming apparatus according to claim 16, wherein
20 the cutting element is mounted to the frame so as to allow
for angular adjustment of the cutting element relative to
the frame.

18. A shearing assembly for use in cutting a profiled
metal section into discrete lengths, the shearing assembly
25 comprising an assembly frame, a shearing block attached to
the frame and operative to receive the profiled metal
section, and a cutting element which is moveable relative
to the shearing block, wherein the shearing assembly is
height adjustable so that the relative height of the
30 shearing block can be adjusted, and wherein the angle of
the cutting element relative to the frame can be adjusted.

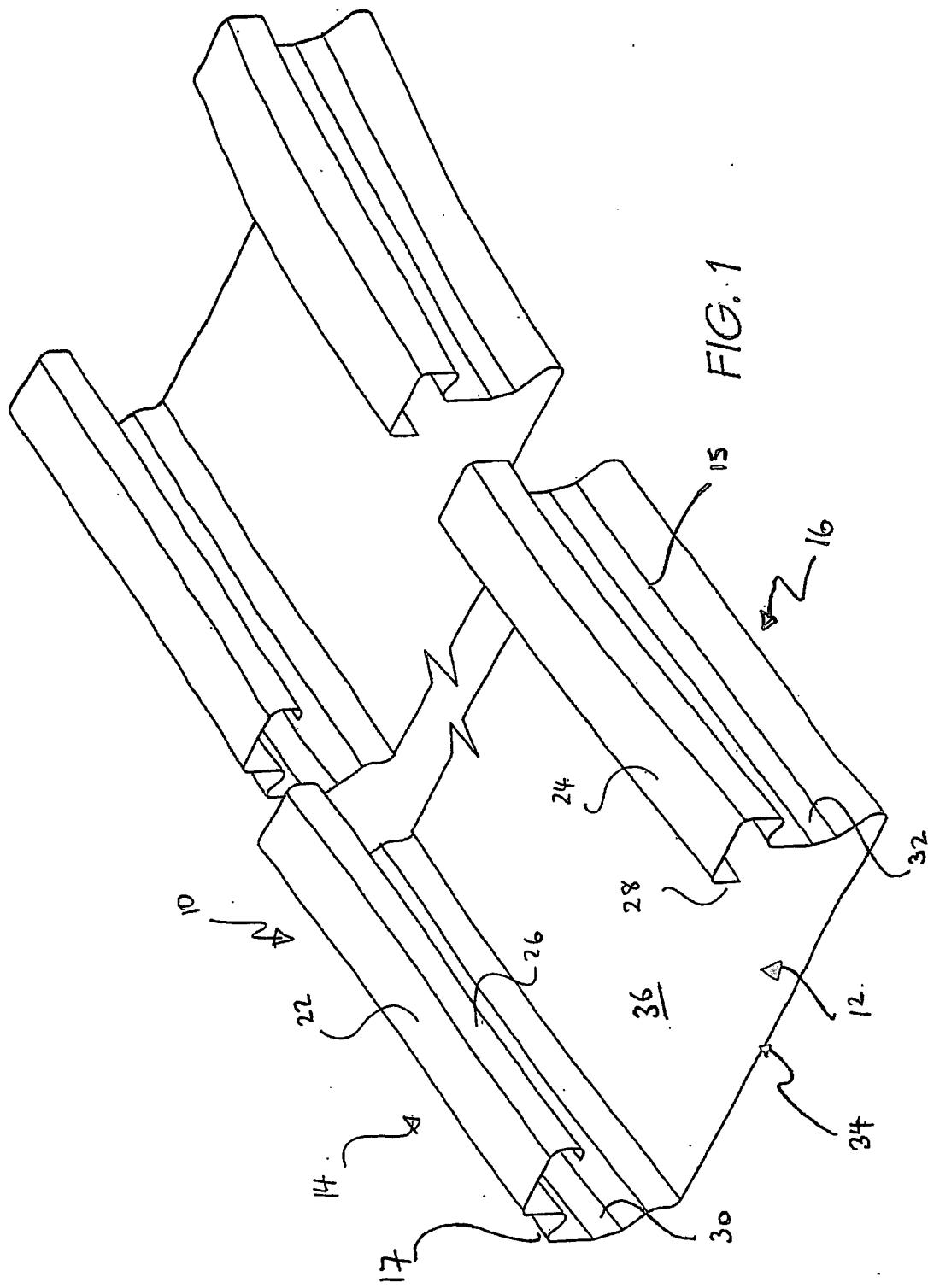
19. A shearing assembly according to claim 18, wherein
the cutting element is pivotally mounted to the assembly
frame.

35 20. A shearing assembly according to either claims 18 or
19, wherein the angle of both the cutting element and the
shearing block relative to the frame can be adjusted.

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21. A shearing assembly according to claim 20, wherein the cutting element and shearing block are mounted to a common sub-frame pivotally mounted to the assembly frame.

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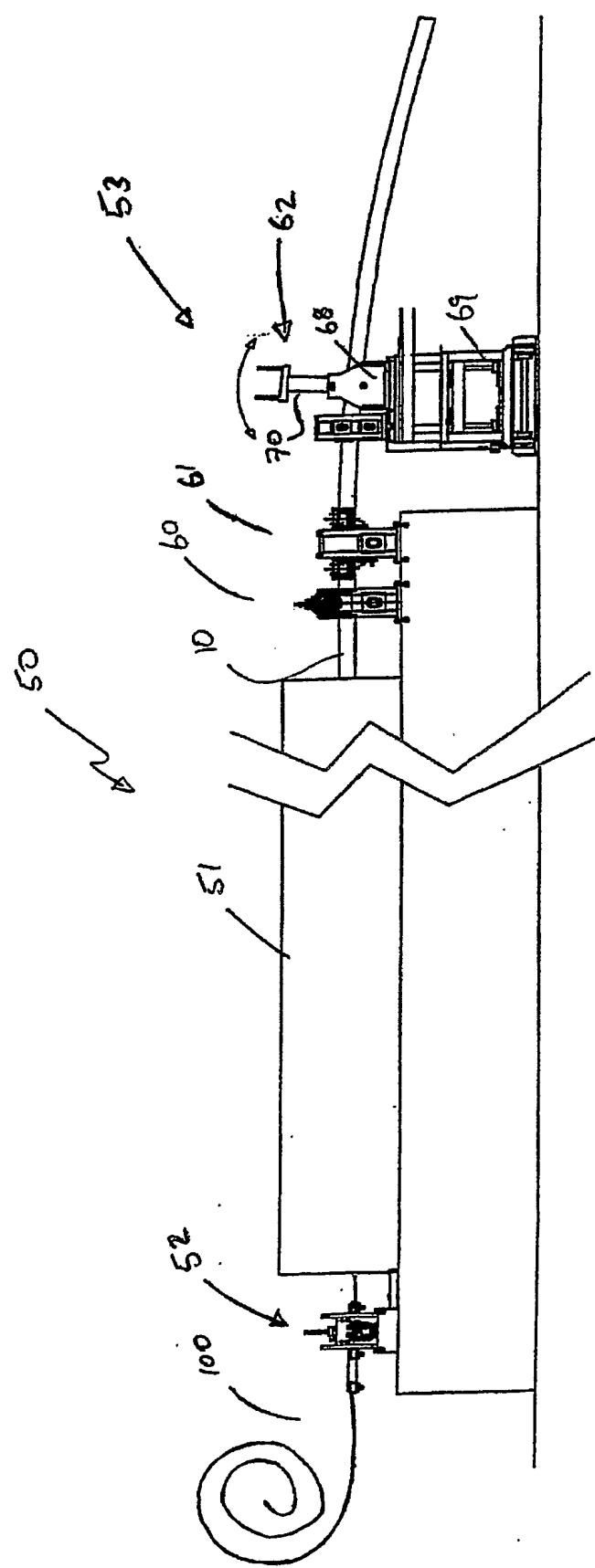


FIG. 2

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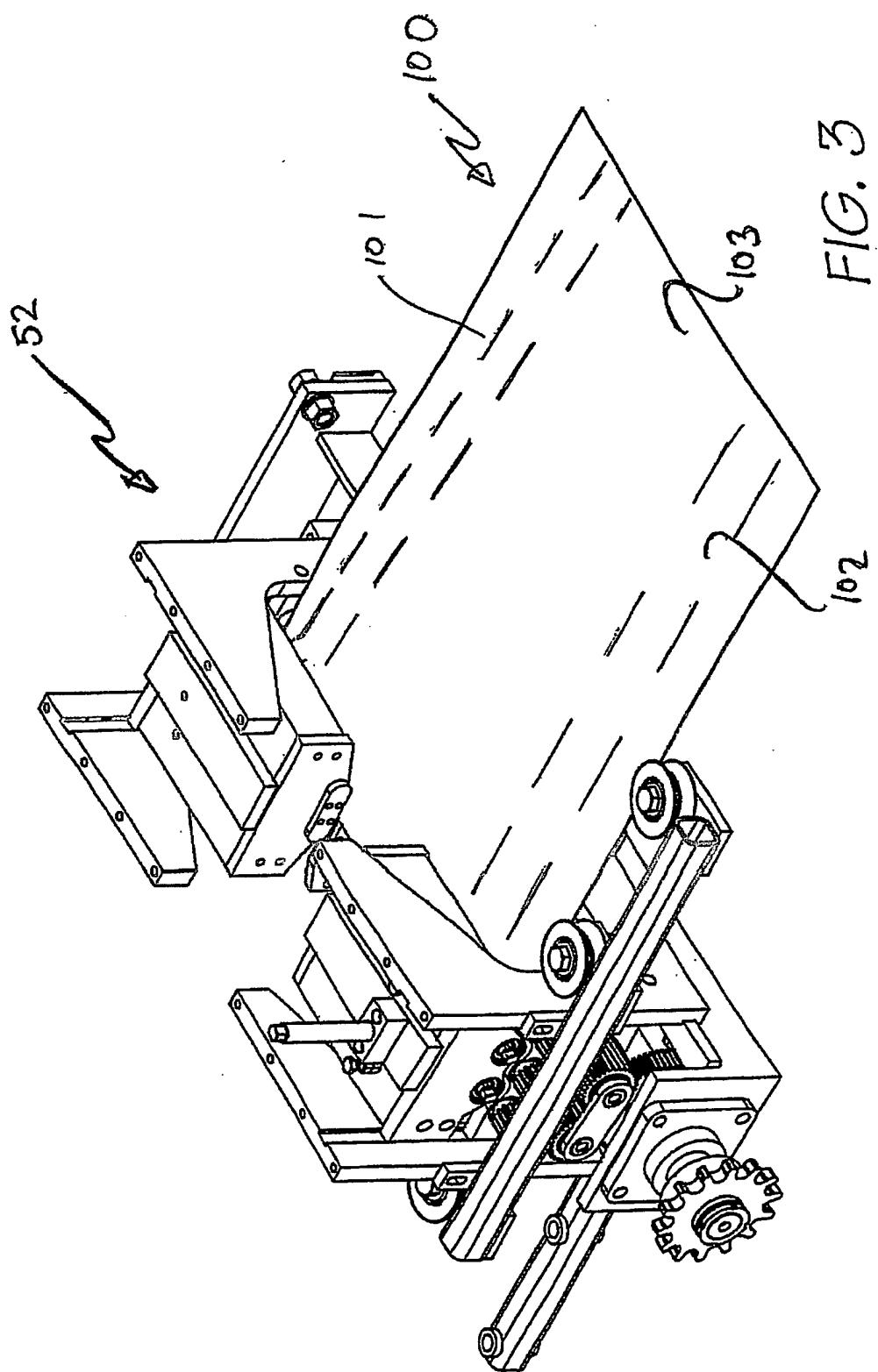


FIG. 3

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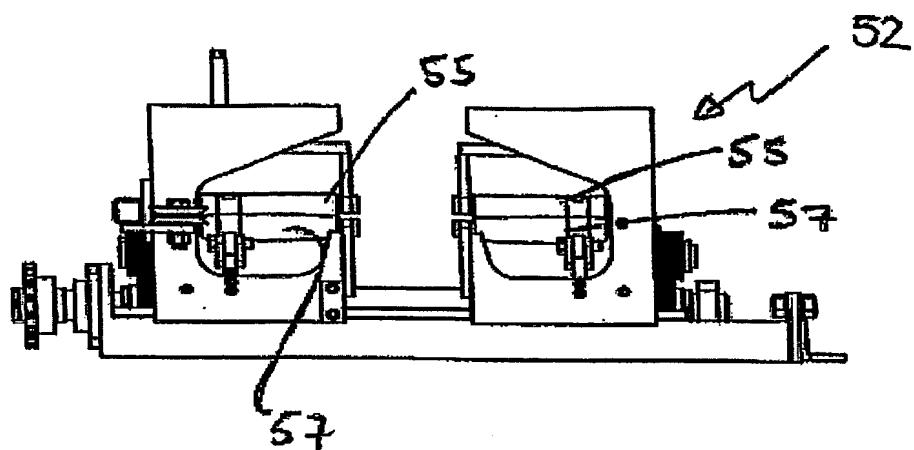


FIG. 4

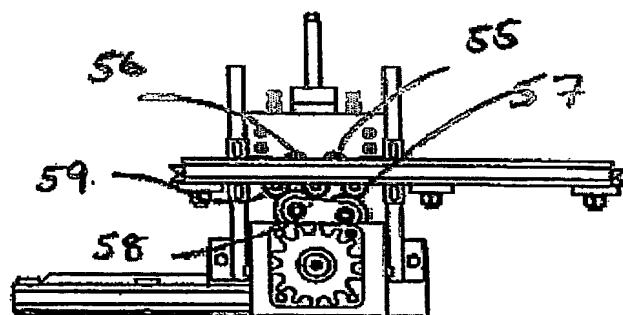


FIG. 5

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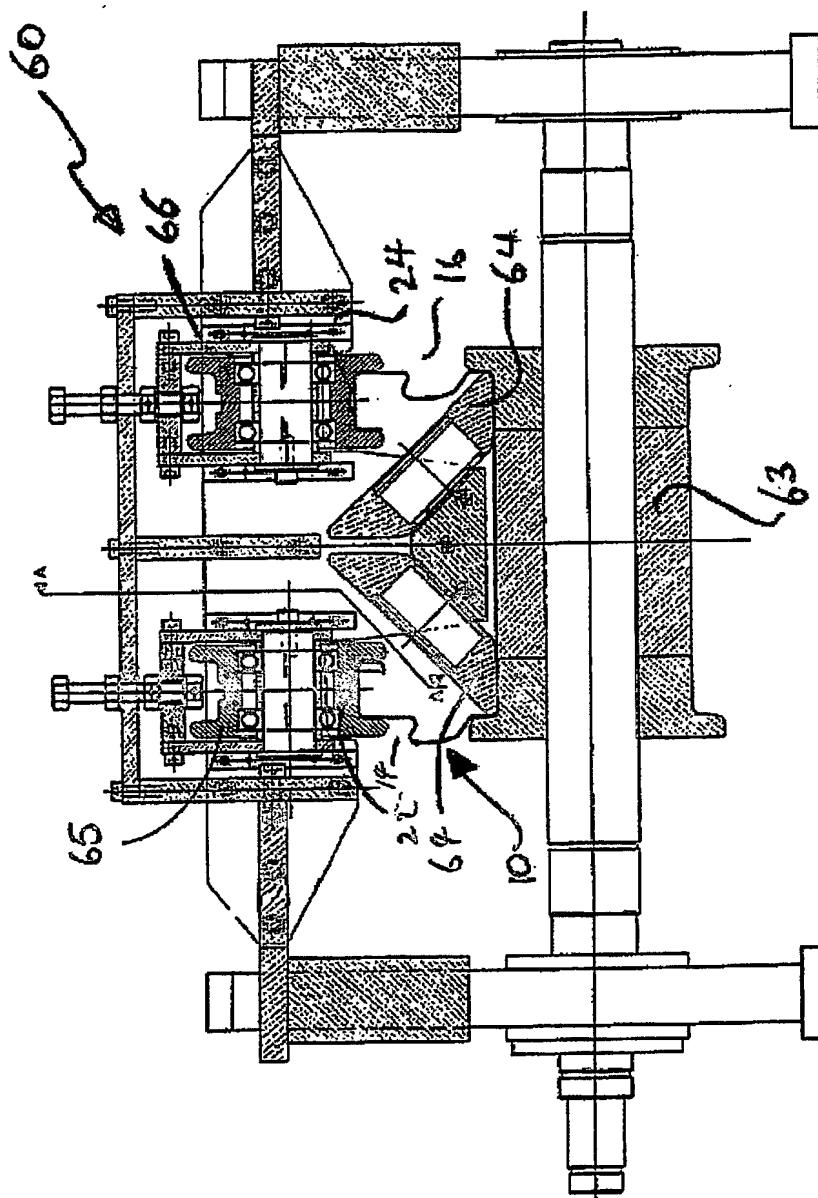


FIG. 6

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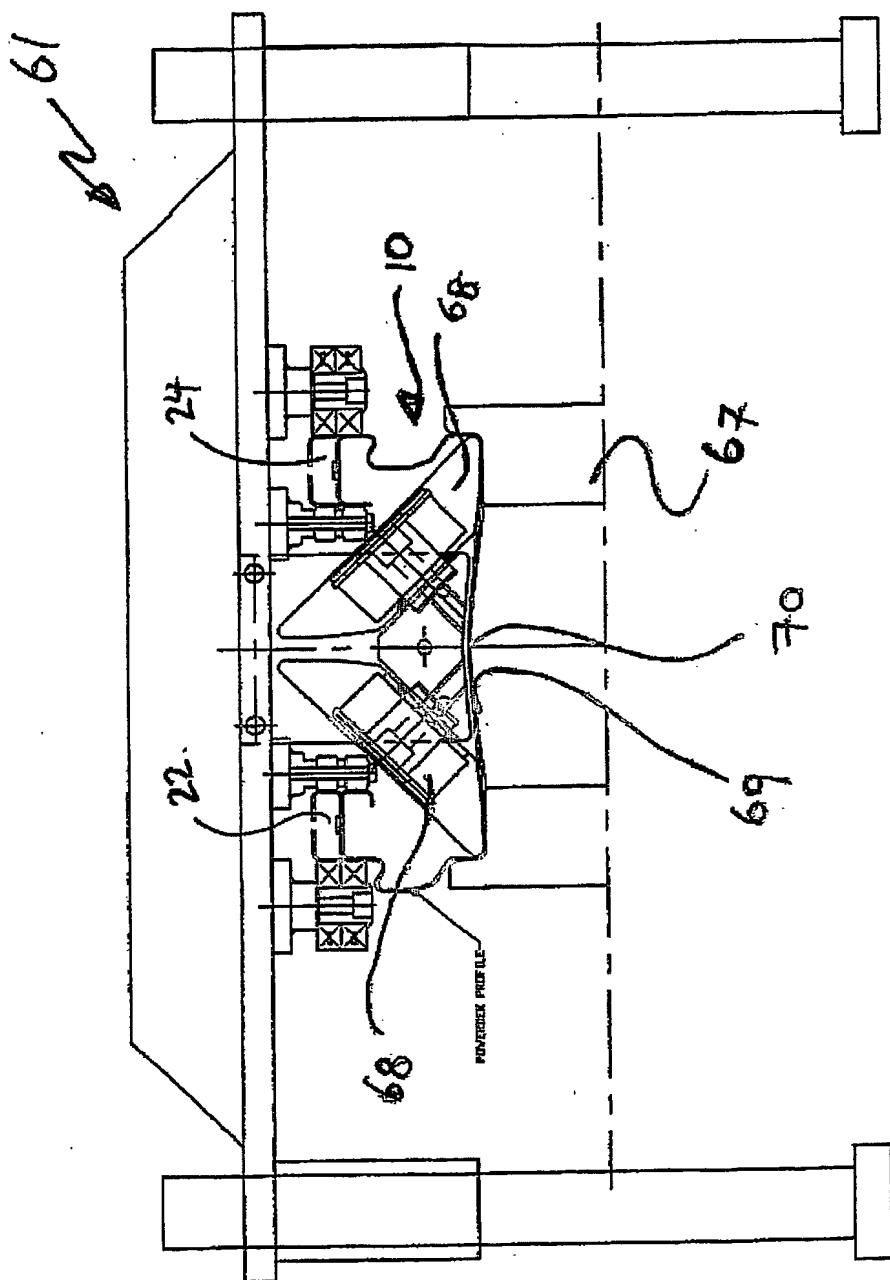


FIG. 7

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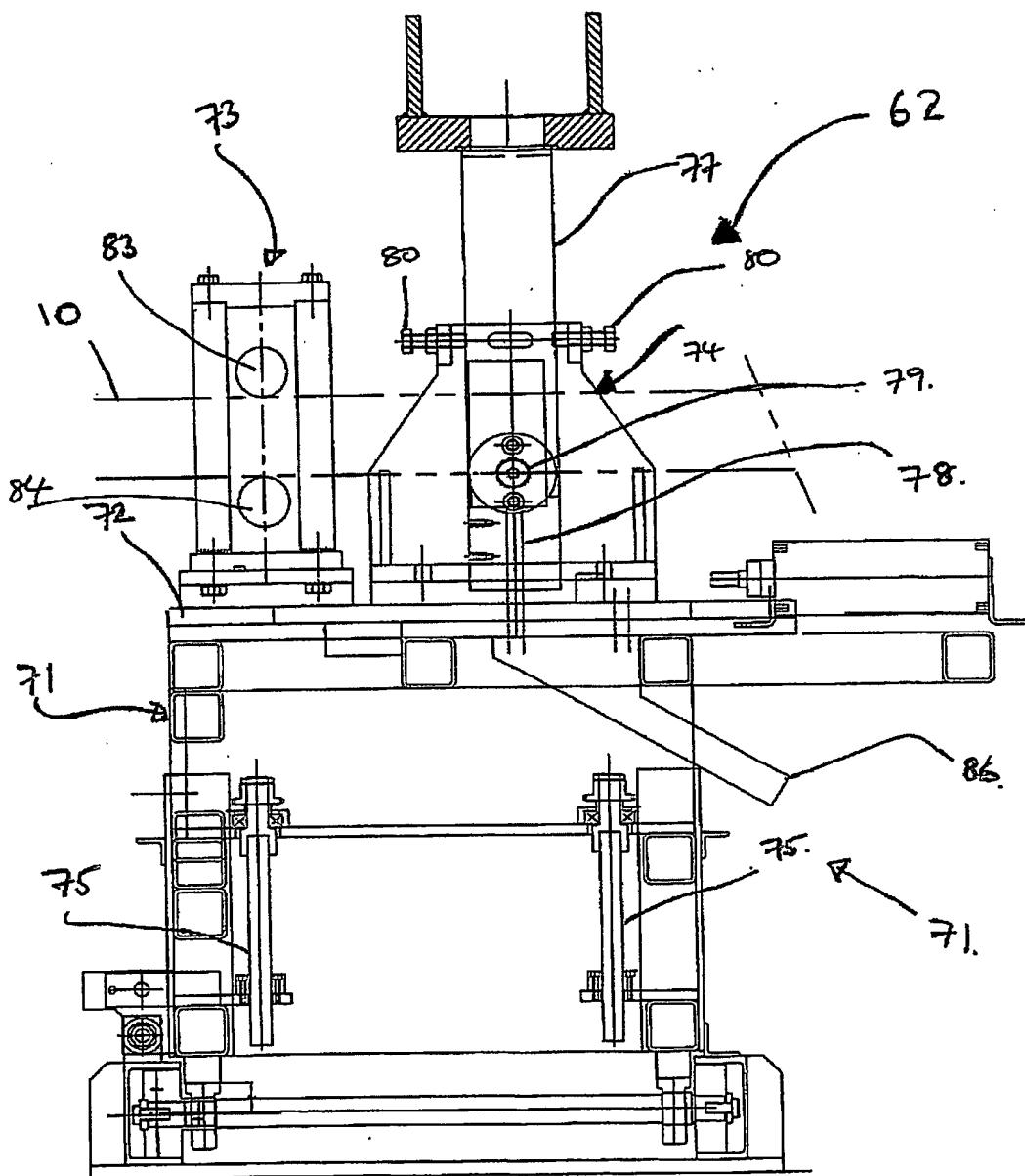


FIG. 8

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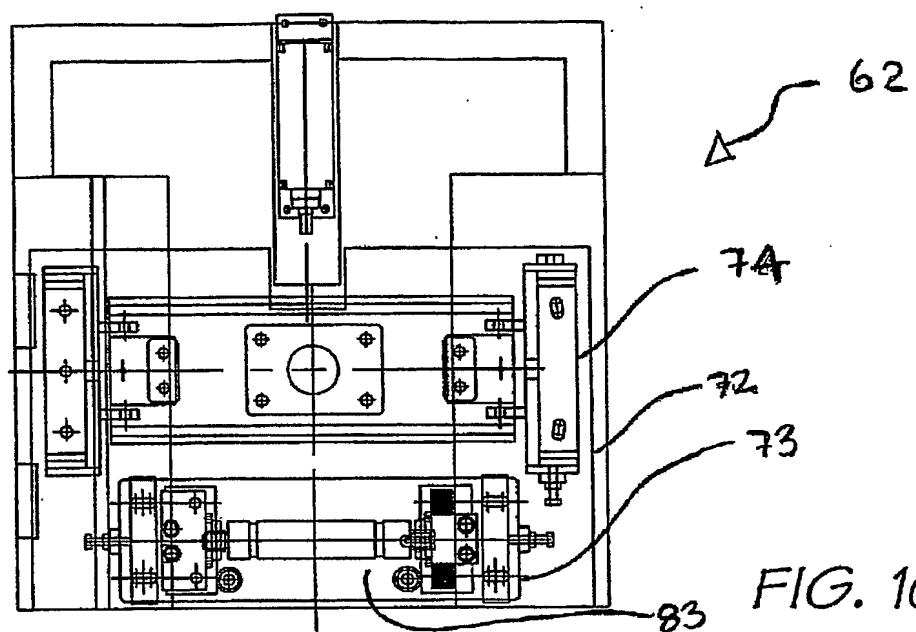


FIG. 10

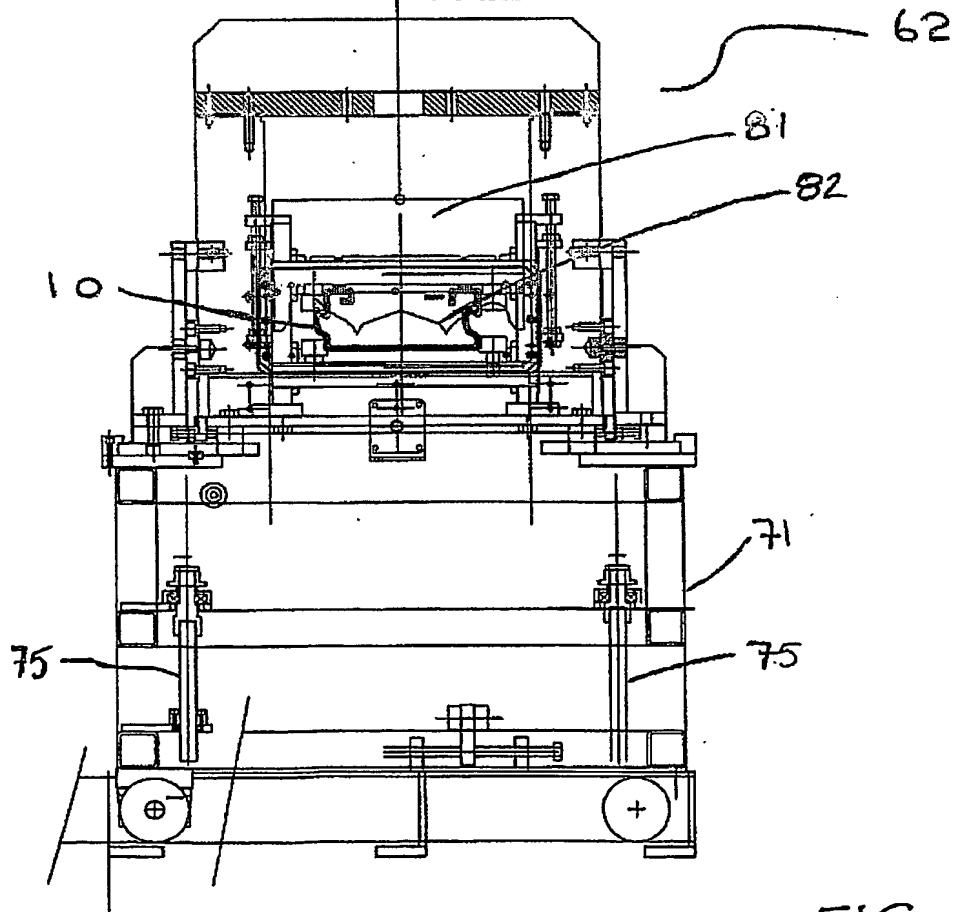


FIG. 9

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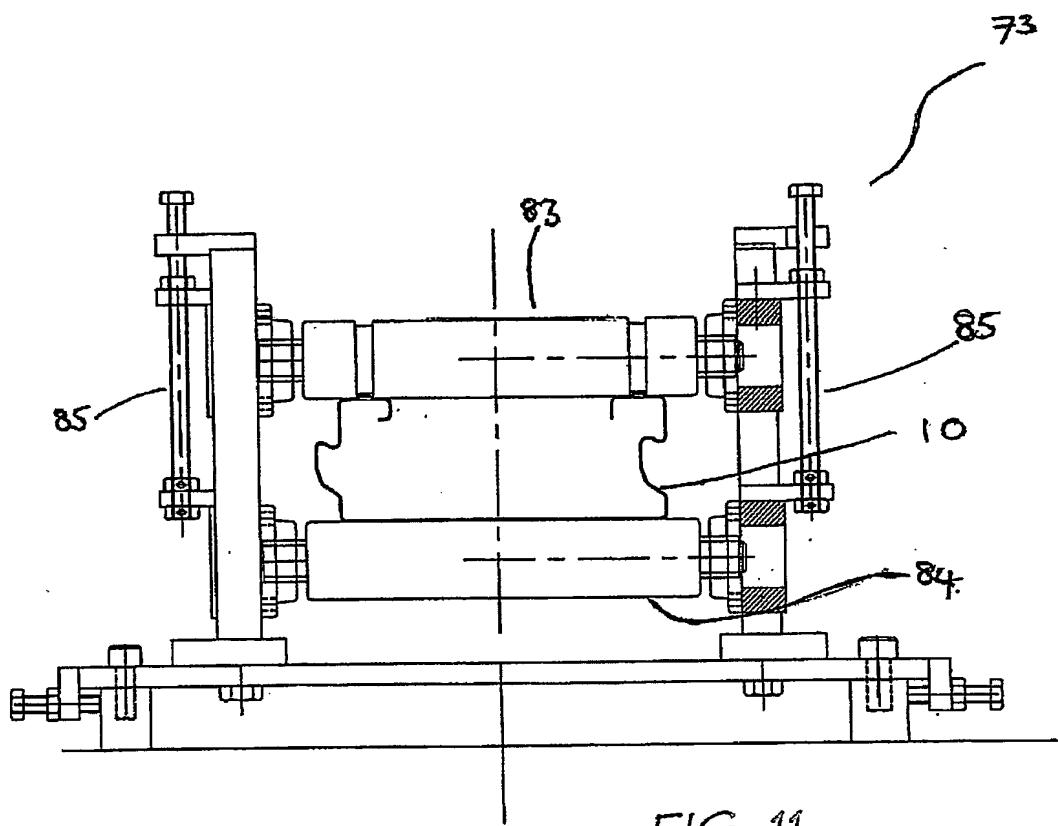


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2004/000366

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. 7: B21B 15/00, 37/56, 37/68, B21D 1/05, 11/12, 13/04, 43/28, B23D 15/04, 17/00, 23/00, 23/02, B26D 1/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT (Above IPC marks and keywords: precamber, stretch, shear, profile, angle and like terms)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 10145/02 A (BHP STEEL (JLA) PTY LTD) 18 July 2002 Page 5 lines 25 - 31	1 - 17
A	WO 2002038885 A (BHP STEEL (JLA) PTY LTD) 16 May 2002 (the equivalent of PCT/AU01/01446 mentioned in the description) page 3 lines 16 - 20	1 - 17
A	GB 2045129 A (MANNESMANN DEMAG AG) 29 October 1980 Abstract	1 - 17
A	WO 2002022327 A (SHEAR LLC) 21 March 2002 Abstract, Figure 6	18 - 21
A	GB 1297182 A (SCHLOEMANN AG) 22 November 1972 Figures	18 - 21
A	Derwent Abstract Accession No. 96-137958/14, Class M21, RU 2039638 A (BELO METAL WKS) 20 July 1995 Abstract	18 - 21

Further documents are listed in the continuation of Box C

See patent family annex

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"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
15 June 2004

Date of mailing of the international search report
01 JUL 2004

Name and mailing address of the ISA/AU

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/000366

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The claims 1 - 17 relate to a method/ apparatus for roll forming a metal section. It is considered that "differentially stretching a metal strip, forming a profiled section and bending the profiled section so as to introduce a longitudinal precamber in the profiled section" comprises the first special technical feature.

The claims 18 - 21 relate to a shearing assembly for use in cutting a profiled metal section. It is considered that "an assembly frame, a shearing block and a cutting element" comprises the second special technical feature.

Since these groups of claims do not share any of the special technical features identified, a technical relationship between the inventions does not exist. Accordingly the claims do not relate to one invention or to a single inventive concept

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
 No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2004/000366

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
AU	10145/02	CN	1365863				
WO	2002038885	AU	13679/02	AU	23268/02	EP	1337723
		WO	0238880				
GB	2045129	DE	2911983	FR	2452336	JP	55141327
WO	2002022327	AU	57235/98	AU	90770/01	CA	2275272
		EP	1007298	EP	1366844	US	5943930
		US	6116131	US	6439089	US	2002157512
		WO	9828114	WO	02076683		
GB	1297182	DE	1923203	FR	2047414		
RU	2039638						
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.							
END OF ANNEX							